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Batteries for Space

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Title: Lithium Battery Space Experiment

Abstract

Performance parameters of lithium chemistries make them a likely candidate to replace NiCd batteries on satellites and spacecraft. Li-TiS2 batteries are 3-4 times lighter than the equivalent NiCd counterparts. Many planners of future space missions, that will use batteries, are interested in the lithium technology which means that lithium battery manufacturers will have a new market to pursue. JPL is proceeding on a course that should facilitate opening this market. A ground based program is developing AA and 3 Ah cells using the Teguchi method.

The In-Space Technology Experiments Program selected the Jet Propulsion Laboratory to conduct a Phase A study of the Lithium Battery Experiment. The paper will describe the experiment and what benefits it will bring for NASA and commercial aerospace. The experiment will mark the first time a rechargeable lithium battery will be flown in space. It is very important to conduct space tests of these new battery chemistries. Lithium cells employ organic electrolytes with low concentration of charge carriers. In such electrolytes, limiting current can be a strong function of micro gravity. The operation of the battery involves lithium deposition and dissolution processes. Micro gravity influences these processes significantly.

The experiment will check the rate capability, discharge voltage, capacity and the phenomena affecting cycle life. There will be two types of experiments conducted. The first set of tests will be set up to determine the effects of electrical performance characteristics

such as rate capability, capacity, operating voltage, and specific energy. The electrical performance tests will be conducted at increasing discharge rates and constant charge rate. The second series of tests will investigate the cycle life phenomena. The charge rates will be sequentially increasing keeping a constant discharge rate for each group of cells. The flight test sequence will be repeated on the ground. Four types of cells will be tested: lithium titanium disulfide, lithium ion, lithium polymer and lithium ion polymer. The cells will all be 1 Ah size. There will be enough cells in each test to assure good replication of results.

There will be post flight analysis of cells. The individual cell capacities and weights will be measured. The flight cells and control cells will be disassembled in dry box., All plates separators and electrolytes will be examined at the surfaces and in the cross sections. SEM inspections will be conducted. The main value of the experiment will be in establishing possible correlations of experimental data with theory. These correlations will be used to suggest design modifications to improve performance of lithium batteries in micro gravity.